Claims

1. A method for tracking the trajectory in three-dimensions and in time of an object in a sample volume comprising the steps of:

    a) recording a time-spaced sequence of digital in-line holograms, generating a sequence of N holograms;

    b) subtracting from a first hologram a second hologram in each successive pair of the sequence of N holograms to generate $N/2$ difference holograms;

    c) summing the $N/2$ difference holograms to generate a summed hologram; and

    d) reconstructing images of the object at a plurality of depths into the sample volume representing the trajectory of the object.

2. A method for tracking the trajectory in three-dimensions and in time of an object in a sample volume comprising the steps of:

    a) recording a time-spaced sequence of digital in-line holograms, generating a sequence of N holograms;

    b) subtracting a first hologram from each of the remaining holograms of the sequence of N holograms to generate $N-1$ difference holograms;

    c) summing the $N-1$ difference holograms to generate a summed hologram; and

    d) reconstructing images of the object at a plurality of depths into the sample volume representing the trajectory of the object.

3. A method for tracking the trajectory in three-dimensions and in time of an object in a sample volume comprising the steps of:

    a) recording a time-spaced sequence of digital in-line holograms, generating a sequence of N holograms;

5   b) subtracting a first hologram from each of the remaining holograms of the sequence of N holograms to generate N-1 difference holograms;

    c) reconstructing an image of the object at a depth into the sample volume for each of the N-1 difference holograms, generating N-1 subject images; and

    d) combining the N-1 subject images to generate a 3-D image representing the
10   trajectory of the object.

4. A method for tracking the trajectory in three-dimensions and in time of a plurality of objects in a sample volume comprising the steps of:

    a) recording a digital in-line hologram as a first series of pixels in a buffer;

    b) for a subsequent time-spaced sequence of digital in-line holograms, recording
15   each hologram represented as a second series of pixels by:

        subtracting each pixel in the second series of pixels from a corresponding pixel in the buffer, for a hologram having an even ordinal number in the sequence of digital in-line holograms and

        adding each pixel in the second series of pixels to a corresponding pixel in
20   the buffer, for a hologram having an odd ordinal number in the sequence of digital in-line holograms; and

    c) reconstructing images of the object at a plurality of depths into the sample volume representing the trajectory of the object.

5. The method of any one of claims 1 to 4, wherein the steps of reconstructing uses a
25 Kirchhoff-Helmholtz transform to obtain an image at a reconstruction plane for each of the plurality of depths in the sample volume.